Scientific resilience: How Italian nuclear physics changed after the Chernobyl disaster

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What do you see?

Research Questions

1. How does **human capital** adapt to sectoral shocks?

2. Are scientific competences completely **sector-specific**?

3. Are scientists able to push the **scientific frontier** outside their main field?

This paper

- Exploits the 1986 Chernobyl disaster
  - Italy cut funds to **nuclear research** in 1987
- Studies the effects on academic publications
- Aims to estimate whether scientists were able to relocate to **new fields**

Preview of Results

- Compared to non-defunded fields,
  - 50% decrease of papers published in **fission**
- For researchers who had already published in **fission**
  - 7% decrease in papers published in the following 15 years
  - 24% decrease in citations received in the following 15 years

Contribution to the Literature

1. **Economics of Science** (researchers' careers):
   - Waldinger (2010), Borjas and Doran (2012), Iaria, Schwarz, and Waldinger (2018), Azoulay, Zivin, and Wang (2010), Myers (2020), and Baruffaldi and Gaessler (2021)
   - Nuclear scientists were not fully able to contribute to new fields
2. **Labor** (human capital specificity):
   - Becker (1962), Lazear (2009), Deming and Noray (2020), Chen (2021), and Aghion et al. (2022)
   - High-skilled workers' human capital exhibits a high degree of specificity
3. **Innovation** (spillovers from public research):
   - Moretti, Steinwender, and Van Reenen (2019), Bhattacharya (2021), Azoulay, Graff Zivin, et al. (2019), Akcigit, Hanley, and Serrano-Velarde (2021), and Gross and Sampat (2020)
   - Failed projects do not generate positive spillovers

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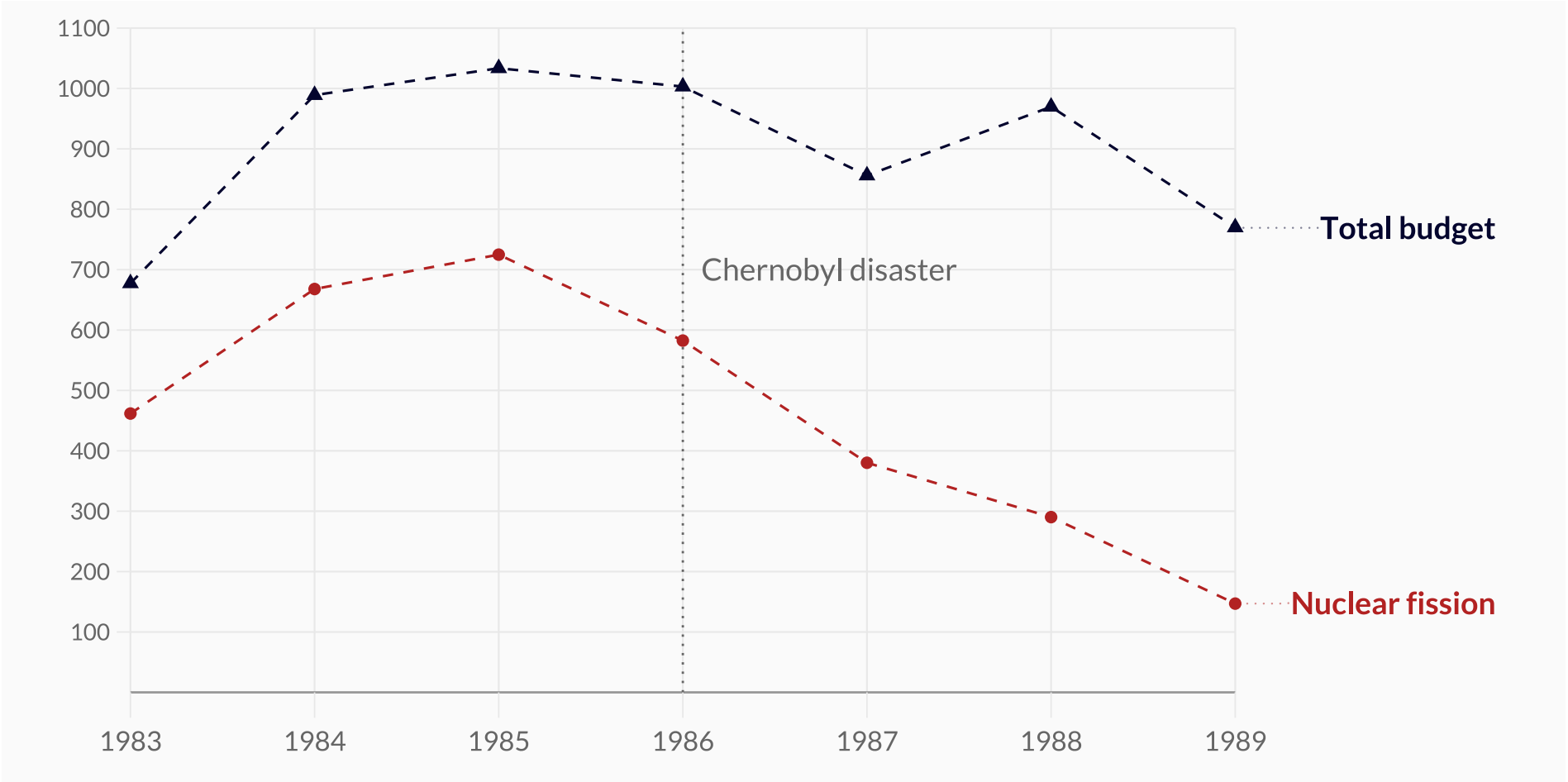
Data sources and sample

- **Microsoft Academic Graph** on scientific publications:
  - title
  - author names
  - author affiliations
  - publication year
  - field of studies
- Selected samples:
  - **publications** in nuclear physics in 1980-1995.
  - **researchers** active in nuclear physics pre-Chernobyl (years 1972-1985).
- Additional data source on nuclear research budget:
  - *Decreto-legge n.151* (1989)

Defunding nuclear research: cuts to ENEA budget



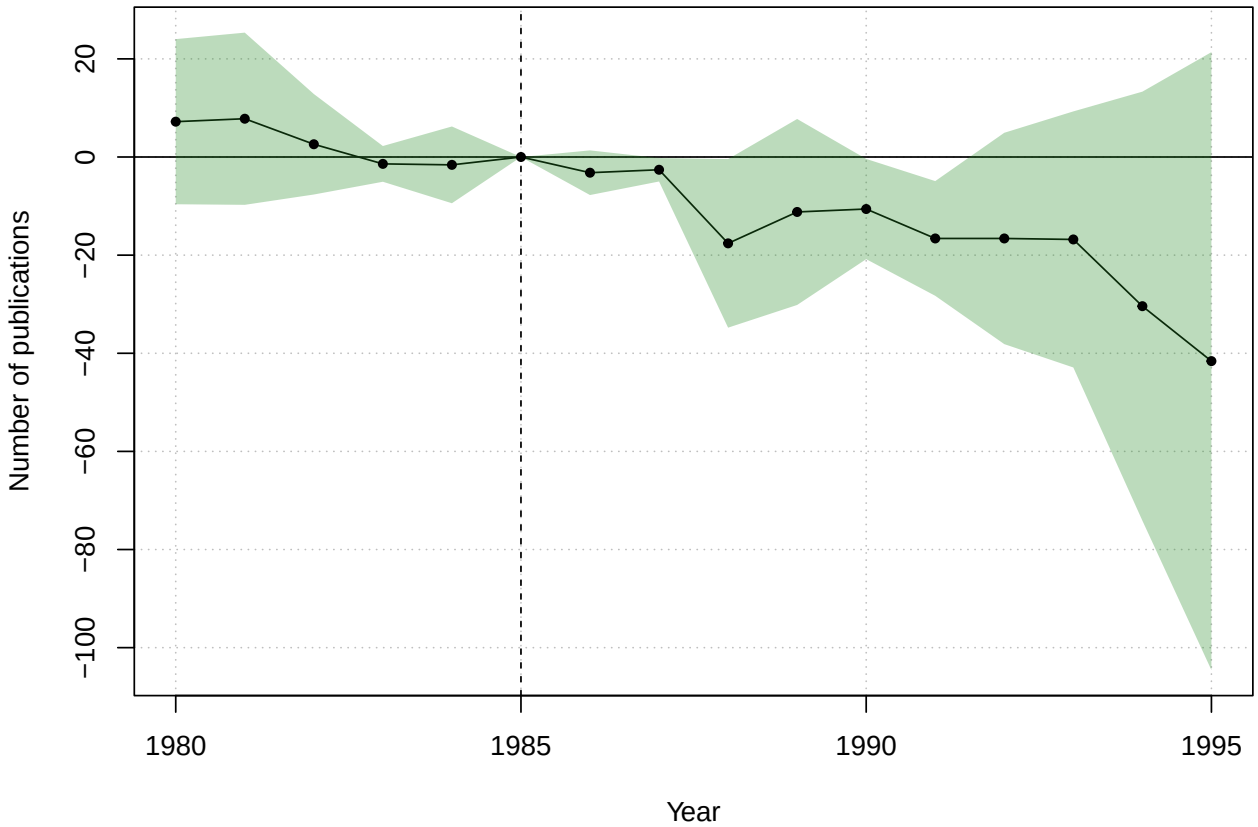
Figures in bln liras. 1000 bln. liras in 1985 $\approx$ 1.28 bln euros in 2022

Comparing fission to non-affected fields

$$y_{ft} = \alpha + \beta Treat_f + \gamma Post_t + \delta Post_t \times Treat_f + \theta_t + \epsilon_{ft}$$

- y_{ft}: number of publications in year t, field f
- $Treat_f$: indicator for the treated field (fission)
- Control group is made of other fields of physics
- $Post_t$: indicator for Post-Chernobyl years
- θ_t: year-specific fixed effects

Fission publications fall by 50% in 10 years



Control group is made of publications in semiclassical physics, medical physics, engineering physics, theoretical physics and quantum mechanics.

Fission publications fall by 50% in 10 years

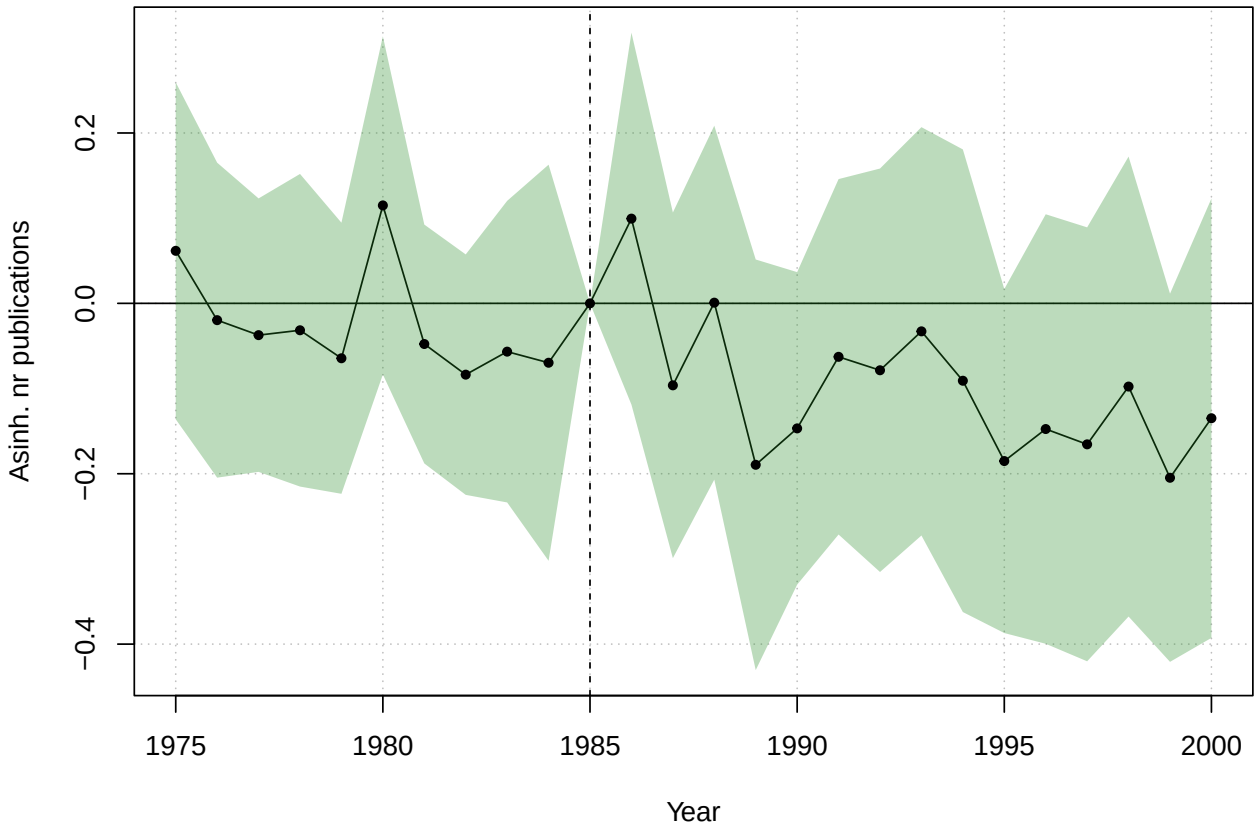
	Nr. of publications	Log nr. publications	Asinh nr. publications
	(1)	(2)	(3)
Post × *Treat*	−7.109***	−0.561**	−0.604*
	(1.579)	(0.259)	(0.322)
Year F.E.	Yes	Yes	Yes
N	32	32	32
R^2	0.920	0.906	0.902

Comparing scientists careers

$$y_{it} = \alpha_i + \delta Post_t \times Treat_i + \theta_t + \epsilon_{it}$$

- y_{it}: (log) number of publications (or citations) by author i in year t
- $Treat_i$: indicator for authors who had published in fission pre-1986
- $Post_t$: indicator for Post-Chernobyl years
- α_i: author-specific fixed effects
- θ_t: year-specific fixed effects

Fission scientists publications fall by 7% in 15 years



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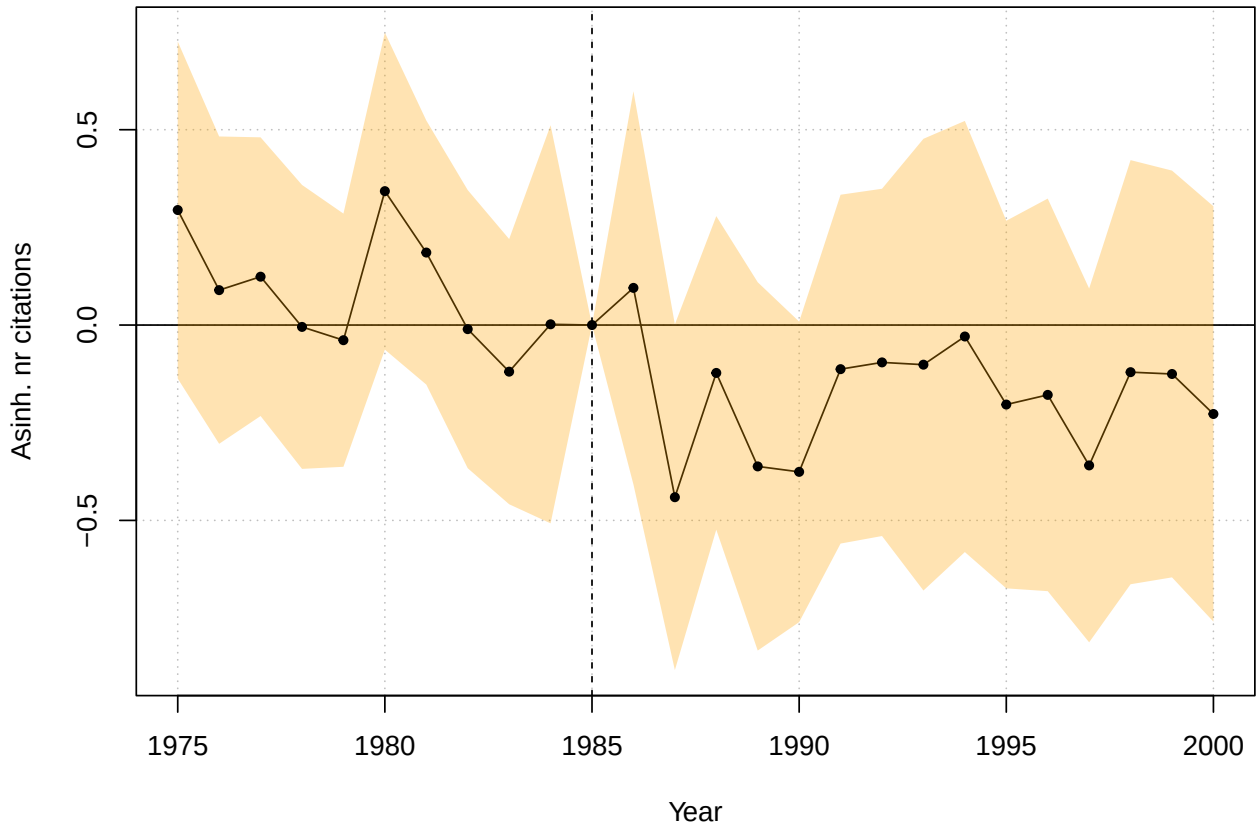
Fission scientists publications fall by 7% in 15 years

	Nr. publications (1)	Log nr. publications (2)	Asinh nr. publications (3)
Post × *Treat*	-0.4460	-0.0661	-0.0809
	(0.1643)	(0.0554)	(0.0713)
R^2	0.50255	0.56955	0.56973
Observations	50,440	50,440	50,440
Author F.E.	✓	✓	✓
Year F.E.	✓	✓	✓

Fission scientists citations fall by 24% in 15 years



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Fission scientists citations fall by 24% in 15 years

	Nr. citations (1)	Log nr. citations (2)	Asinh nr. citations (3)
Post × *Treat*	-19.85	-0.2348	-0.2626
	(3.457)	(0.1316)	(0.1547)
R^2	0.27507	0.53915	0.53835
Observations	50,440	50,440	50,440
Author F.E.	✓	✓	✓
Year F.E.	✓	✓	✓

Conclusions and discussion

- **Findings**
  - Sizable loss of scientific production after defunding
  - Italian nuclear scientists did not successfully relocate
- **Limitations**
  - Small sample size
  - No budgetary data to measure elasticity of science w.r.t to fundings
  - No clear measure for transition to new fields

What's next?

- Enlarge sample size: add fields that cite the ones that I selected
- Use ML algorithms to define an index of field similarity
- Define transition to new fields accordingly
- Check for heterogeneous effects
- Explore different control groups